Design of Nasal Ultrasound: A Pilot Study

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ABSTRACT

An A-scan ultrasound gives us one dimensional information about the area of interest in the body being examined. Paranasal sinuses are empty air-filled cavities whose functions are to support the weight of the skull, introduce resonance to voice and condition the respired air. They are located in the nasal cavity -maxillary sinuses, above the eyes-frontal sinuses, between the eyes-ethmoidal sinuses and behind the ethmoids-sphenoidal sinuses. The objective of our project is to design an A-mode ultrasound system for the detection of paranasal sinusitis, primarily maxillary sinus. The existent conventionally used methods for detection of paranasal sinuses are the X-ray and CT methods. This amounts to large radiation dose every time the patient undergoes an examination and is more expensive. The reasons behind choosing to use the ultrasound method are that it is relatively inexpensive and can be made portable. It is safe as no ionizing radiation is used. Since the ultrasound technique has limited bone penetration which restricts its use to maxillary sinuses alone.

Keywords: A-Mode Ultrasound, ENT, Maxillary Sinus, Paranasal Sinuses, Receiver, Sinusitis, Transmitter

INTRODUCTION

The inflammation of the paranasal sinuses due to infection, allergy or immunity problems is called sinusitis. Consequently fluid fills these air spaces. This condition can be either acute, sub-acute or chronic.

Etiology

- Nasal infections like common cold and influenza.
- Nasal obstruction caused by deviated nasal septum, polyps or growths in the sinus.
- Nasal allergy which causes blockage of the nose and obstruct the drainage of sinus.

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While swimming and diving water enters the nose forcefully.

Dental infection due to molar or premolar infections.

The use of ultrasound in medicine can be divided into two major areas – therapeutic and diagnostic. Our project comes under the diagnostic area of applications. Ultrasound waves are highly directional, inaudible and high frequency waves at shorter wavelengths can be used to investigate smaller structures. All these properties make it highly suitable for ENT applications.

The currently used methods for detection of paranasal sinuses are the X-ray and CT methods. These are highly ionizing due to the radiations used, are expensive and non-portable. To overcome these difficulties we proposed the use of A-mode ultrasound system to detect paranasal sinusitis, since A-mode ultrasound is useful in the detection of secretions within the sinus and not mucosal thickening (Rohr et al., 1986).

**LITERATURE REVIEW**

Initially, a procedure called nasal trans illumination test was performed to detect sinusitis, where a fine tipped light source was used to detect obstruction of the sinuses and if the sinuses were normal a red dot would be seen when the light passes through the delicate skin (Wald et al., 1981; Bock et al., 1994; Druce, 1992; Fister et al., 1994; Shapiro et al., 1986; Savolainen et al., 1997). If not then an operation like CALDWELL-LUC or proof puncture would be performed. However later trans illumination became an obsolete method for this purpose (Oten & Grote, 1989). The disadvantages of this method are many like the need to cover the eyes to protect them from the light and difficulty in determining presence of any fluid due to sinus infection.

Then CT scans became the most preferred method by the doctors to determine the presence of sinus infections, since it picks up the sinuses really well, after which an operation called FESS is performed. The disadvantages here are the production of harmful ionizing radiations which is dangerous to the patient especially children. Hence, there is a need to develop a system that is safe and accurate to detect sinusitis.